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F I R E   P R O T E C T I O N

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STRUCTURAL FIRE PROTECTION TODAY   Eric L. Bird, M.B.E., M.C., A.R.I.B.A.,

The first object of fire protection is to ensure safety of life; the second is to preserve from damage, resulting from the occasional outbreak, the activities (or occupancies) housed in buildings. Occupancies are usually of greater value, both intrinsic and monetary, than the buildings themselves.

Fire protection can be subdivided into three parts namely:- (I) Fire prevention, which is or should be mainly the concern of the occupants of buildings. (2) Fire fighting which is the business of firemen, but which includes attack on incipient outbreaks with hand or automatic equipment. (3) Structural fire protection which is the responsibility of architects and local authorities. This last is the subject which I shall principally discuss.

When an aircraft crashed into the Empire State Building, hurling some 1,500 gallons of flaming petrol into it, the New York Fire Brigade were able to fight the fire at a height of 700 feet above the street, getting it under control in 19 minutes and out in 40, while the occupants of the 10 storeys above the fire walked down through the protected staircases to safe storeys below. That achievement was made possible only by the proper application to the original design of structural fire protection principles.

THE PRINCIPLES OF COMPARTMENTING

The confining of a fire to manageable dimensions in a large building means its subdivision into a series of fire-tight compartments. The simplest and a traditional example of compartmenting is the subdivision by means of fire-resisting party walls of a terrace of dwellings which otherwise would form a single fire risk. Today we have to create superimposed compartments in multi-storey buildings.

This has two features. First, the use of structural elements of known fire-resistance and appropriate grade to form the boundaries of each compartment and the supports in it. Second, the use of various devices, principally fire-resisting doors, to prevent fire passing between compartments through the essential openings of doorways, stairs, lifts, windows and ducts.

rightly
Strain
Self closing
doors.

The fire-resistance of most types of structural element in use today has been determined at the Fire Research Station at Elstree and published in National Building Studies Research Paper No. 12. This feature of compartmenting is now reflected in building byelaws and fairly generally accepted, though there are still far too many instances in new building

Necessary for fire resisting walls to be unperforated. Sometimes services are brought through fire resisting enclosures.

where reinforced concrete floors are supported on unprotected steel-work and where enclosure by structural elements is incomplete, revealing that the designer has not understood the basic principles of compartmenting.

Much less well understood and practised is the protection of openings. Without such protection, the use of fire-resisting construction is almost useless because fire can pass throughout the building, destroying the contents, endangering lives and leaving nothing but a fire-racked shell. All staircases and lift shafts in multi-storoy buildings ought to be enclosed in vertical compartments of fire-resisting construction and cut off at all levels by self-closing fire-resisting doors. This arrests the especially dangerous "flue-effect" of hot gases and smoke, which otherwise will rise quickly by convection up the shafts of stairs and lifts. The all-too-common provision of an open "grand" staircase in a multi-storey building, together with protected escape staircases elsewhere, as is to be seen, for example, in many provincial hotels is, in my opinion, dangerous because the flue effect is not arrested. An air temperature of 300° Fahr. is lethal and this can be quickly attained in upper floor corridors and thus prevent persons reaching the protected escape staircases. Moreover there have been many cases of fires in basements igniting roofs, with little if any damage in intermediate storeys.

ESCAPE IN MULTI-STOREY BUILDINGS

This brings me to the second requirement - that occupants of buildings should be able to escape easily to a place of safety. A "place of safety" is not necessarily outside the building, though "getting the people out" is a tradition in fire-fighting. In a properly compartmented building another compartment, even a protected staircase, is a place of safety. It should be noted that in the Empire State Building fire, the occupants did not need to leave the building.

In this connection a proposal for hospitals has been advanced by the Fire Panel of the Nuffield Provincial Hospitals Trust. If ward blocks are constructed with two or more compartments on the same level, safety for patients can be achieved by wheeling their beds from the compartment affected into adjoining compartments, a method that is quicker and far less likely to injure the patients than transporting them down and out by lift and staircase to the open air. This the Panel termed "two-stage escape", inferring that in the unlikely event of the fire growing to uncontrollable dimensions the compartmenting would give time for the necessarily slow evacuation of patients by the staff.

Two recent contrasting cases in England illustrate strongly the difference between structural fire protection and its absence. A considerable fire occurred in the parcels dispatch department of Selfridge's store during the winter sales when the store was full of customers. This building is of fire-resisting construction and compartmented, and it is also fitted with sprinklers and automatic fire alarms. So well did the structural fire protection operate that hardly any of the customers even knew of the fire and the business of the store proceeded while the London Fire Brigade extinguished the outbreak. In contrast, a similar store in Manchester, not of fire-resisting construction, not compartmented and not sprinklered was completely destroyed by a fire which spread unimpeded through the interior, fortunately at a time when customers were not present.

FIRE FIGHTING

The third requirement - that firemen must be able to fight a fire at any level - is to a large extent met by proper compartmenting and the protection of staircases. But in tall buildings, pressure water supplies should be available through wet or dry risers on all storeys and a firemen's lift - one that can be controlled when necessary only be firemen - helps them greatly in their attack on an outbreak at high level.

Today we have abandoned the idea that buildings should be of restricted height and aligned on street frontages so that firemen shall be able to reach any part by ladder. Tall buildings, in which this is not possible, will be dominant features in the future urban scene, whether offices, blocks of flats, hotels, hospitals or technical colleges. To be safe, such buildings must be constructed and equipped according to the principles which I have outlined. The requirements for and and methods usable in fighting fires in such tall buildings have been admirably set out by Mr. F. W. Delve, C.B.E., Chief Officer of the London Fire Brigade, in a paper he gave at the 1957 Conference of the Institution of Fire Engineers. If these principles are adopted I think there need be no limit to the height and cube of buildings, from the point of view of fire safety.

OTHER TYPES OF BUILDING

So far I have discussed this subject mainly in terms of the multi-storey building. There remain four other principal types which we are building now and which we are likely to continue building.

The Small House. Of the ordinary two storey house little more need be said than that the standard of safety set by traditional construction,as specified in the building byclaws, is accepted as tolerable. But any divergence from traditional construction needs to be carefully examined to make sure that this standard is not reduced. An instance of such reduction has been in some cases the substitution for the traditional plaster on walls and ceilings of lining materials which can suffer from spread of surface fire. Another has been the installation of ill-considered designs of non-traditional flue.

The Horizontal Building. This type is wide-spreading, of two to four storeys, used as a school, office, block of flats, small hotel, clinic or institution. Schools are taken care of by the requirements of the Ministry of Education as set out in their Bulletin No. 9 whose provisions are satisfactory - for a day school user. The standards set in Bulletin No.9 could well be adopted for two or three storey office buildings and similar low fire load occupancies where the occupants are alert and awake. But where there is what is termed a "sleeping risk", as in a hotel, hostel, block of flats or boarding school, compartmenting of the storeys with one hour fire-resistance seems desirable. This infers, among other things, the enclosure of all staircases with fire-resisting self-closing doors.

An industrial user in such a building is quite another matter and with some hazardous or high fire load occupancies may well call for two hour fire-resisting compartments. It is this type of factory building which, when not compartmented or having unprotected steelwork, most suffers disastrous fires - fires which are a great strain on fire brigades and a danger to firemen and which not infrequently bring ruin to their owner's business.

A similar degree of structural safety, that is to say compartmenting with two hour fire-resistance, is necessary I suggest in two or three storey buildings which have an "infirmity risk" such as hospitals, nursing homes, maternity homes and homes for the aged, in which the occupants must be carried or helped to safety. The use and conversion of obsolete mansions for such a purpose, in my opinion, can be highly dangerous. It was in a building of this kind that the Effingham hospital disaster occurred in the United States in which some 80 persons died.

The Large Single-Storey Factory. The single-storey factory is tending to replace the old mill-type building as linear mass-production processes are increasingly adopted. These processes demand buildings of great horizontal extent, sometimes even more than one million sq. ft. of floor space. Production methods prohibit compartmenting except the separation by fire-resisting walls of stores and sub-departments, though manufacturers are notoriously lax and ignorant of the possibilities in this direction - at least they were until the Jaguar fire last year administered a salutory jolt.

Those huge buildings with their unprotected steel space-frame roofs, require an approach in respect of fire protection that is quite different from that needed in other building types - one on which there is little basic research as yet. I discussed this problem at some length in an article published in the November 1957 R.I.B.A. Journal and shall not repeat now what I said there. But I would emphasise the apparent value of automatic fire vents in the roof to allow heat to escape, thus lengthening the life of the steelwork and giving firemen more time in which to e tinguish the fire before the roof comes down on their heads. It was collapse of steelwork through confinement of heat which was most responsible for the greatest industrual fire so far, the General Motor Fire at Livonia in Michigan where the damage amounted to more than 50 million dollars.. A recent American practice is to provide "curtain boards" or wide hoods over fire-hazardous items of plant, terminating in automatic vents in the roof, so that heat and smoke are canalised out of the building. But a much wider adoption of automatic sprinklers by British industry would greatly reduce the present annual figure of £12 million of industrial fire damage.

The Public Assembly Building. The safety of human life is dominant in the public assembly building. The technique of planning exits from such buildings - a technique which calls for close attention to detail, often app apparently trivial - is on the whole well understood by the architectural profession, even though there is no universal code to govern practice. In the absence of such a code, many architects wisely follow the rigid rules of the London County Council in regard to provision, planning and detailing of exits, even where the local authority in whose area they are designing a building does not require so high a standard or, in some cases, no standard worthy of the name.

In recent years we have been fairly free in Great Britain from disasters in public assembly buildings, though I have felt distinctly uneasy in some which I have visited. This absence of disasters is due partly to the good sense of most architects but mainly to the watchfulness of the officers in the larger local authorities in connection with the licensing of halls for music and dancing.

SOME NOTES ON STAIRCASES

The difference between an exit and a protected staircase seems to me to be insufficiently understood. A single properly protected staircase for example the type now permitted by the London County Council in blocks of point flats or the one required by them in theatres, is far safer than half a dozen open staircases either inside or outside a building because, if inside, they are prone to become filled quickly with smoke and lethal heat and, if outside, they become dangerous with snow and ice or even exposed to flames issuing from windows. It should not be inferred from this that alternative protected means of escape should not be provided in buildings other than point flats.

Swedish point flats have a single central staircase, without day lighting. To those who do not know of the elaborate precautions in the form of compartmenting, solid entrance doors to each flat, hydrants on alternate landings and smoke vents, these flats appear at first sight to be death-traps. But I have been informed by the Chief State Fire Inspector of Sweden that there has not been one death from fire in a point flat during the 37 years that this type of building has been permitted in Sweden.

It seems therefore that we do not have a monopoly of ideas on means of escape or indeed on fire matters in general, and that we can learn from other nations who are faced with similar problems. For many years it has been a practice in American skyscrapers to place lift batteries, lavatories and escape staircases in a centrally-placed "core" of the building, all without natural lighting. The plan of the Empire State Building is an example. In this country we place escape staircases on outer walls where they can obtain daylight and where they occupy valuable space which might otherwise be used more profitably. Certain safeguards in respect of artificial lighting, double-cut off doors and vents in what Americans term "smoke-proof towers" are necessary. But it seems to me that the internal escape staircase is a technological device we could well adopt in this country. It has

Other countries / Fire Protection in Buildings
~~#~~ W.P.F.R. of C.I.B. results of work quickly transmitted throughout the world.

been proved safe in the United States.

There is, however, one important feature of staircase escapes which requires mention. They need to be maintained in good working order. Too often they are found to be blocked or partly blocked with boxes or pieces of unwanted furniture, or smoke-stop doors are wedged permanently open thus admitting the deadly flue-effect. The escape staircases of assembly buildings such as theatres and cinemas to which local authority offices have access at any time are usually kept in good order. Factories are similarly open to the factory inspectors. But local authority officers have no right of entry to other buildings unless invited. It seems to me that, if the community wish for economic reasons to erect tall buildings, they should be compelled to submit to inspection of such buildings at any time by fire officers in order to ensure that the means of safety for the occupants is maintained in good working order. Until this is done, we shall have to rely on the excellent propaganda among building owners at present undertaken by the Fire Protection Association.

THE DEVELOPMENT OF STRUCTURAL FIRE PROTECTION

It is, I think, worth while reviewing briefly the development of modern structural fire protection in Great Britain, because this allows us to assess the present position. Mention should be made first of the excellent pioneer work early in this century of the British Fire Prevention Committee, in whose operations the R.I.B.A. took a leading part. But research in the modern sense really began with the establishment in 1932 of B.S. 476, now in its revised form entitled Fire Tests on Building Materials and Structures. This B.S., among other matters, established methods of testing structural elements against a time-temperature curve allowing their fire-resistance in terms of time to be ascertained. The opening of the Fire Research Station at Elstree in 1935, paid for by the Fire Offices Committee, provided the means of making the tests. The Station was staffed from the beginning by officers of the Building Research Station, but in 1946 The Fire Offices Committee presented their station to the then newly-formed Joint Fire Research Organization which is a section of the Department of Scientific and Industrial Research. It is perhaps worth noting that B.S. 476 originated in a recommendation of the R.I.B.A. Science Committee.

Another important event, which greatly advanced the technique of structural fire protection and facilitated insertion of the fire grading clauses in the 1953 Model Byelaws, was the establishment in 1942, under the aegis of the Ministry of Works, of what was known as the Fire Grading of Buildings Committee. The Committee's first report, dealing with general principles and structural precautions, was published in 1946 as Post War Building Studies No. 20. Their second report, published in 1952 as Post War Building Studies No.29., covered means of escape, fire-fighting equipment in buildings and flue construction.

These two documents at present form the technical "bible" of structural fire protection. Inevitably many of the recommendations in them are matters of opinion, though the Minister of Works, in convening the Committee, was careful to appoint persons who together covered a wide range of technical knowledge. The Committee in fact formed a consensus of the most expert opinion then obtainable.

More recently the British Standards Institution (in 1957) has appointed a committee to draft a Code of Practice on Protection against Fire. This Committee has - I think correctly - taken the view that structural protection and means of escape ought to be considered in terms of building types, instead of trying to formulate general rules which would be applicable to all. They have therefore begun by studying multi-storey blocks of dwellings and will doubtless proceed to other types in due course.

When ad-hoc committees have reported they cease to exist. From that moment, new research findings, new fire incidents, new types of building and occupancy and new ideas begin to render their reports out of date. There seems to be a need for a permanent central technical body to study what is a continuously developing technique, to establish and recommend rules for general adoption in building and to draw attention to matters which need study. Because the wide field of fire protection is not wholly covered by any one government department or institution, I suggest that establishment by the government of an Advisory Council for Safety in Buildings, somewhat similar in form and standing to the Royal Fine Art Commission. This could be a small body of acknowledged experts and should not, I suggest, be merely one of representatives of Ministries and Institutions. Its findings would carry weight and help towards uniformity in practice and legislation as developments proceed.

FIRE PROTECTION AT PRESENT

The present position appears to be somewhat as follows. A great deal of basic research has been done, but much still remains to do. Perhaps because of this and because the research is of recent date, many architects and many local authority officers have a much weaker grasp of the technique of structural fire protection than they have of other and longer-established techniques such as sanitation, structural stability, heating and ventilation. Moreover expert opinion in the formulation of rules must for a long time play an important part, because the growth of fire in the many varieties of building complexes and the clutter of combustibles which mankind seems to need today is not easily predictible. Means of escape, also, is not amenable to scientific measurement and someone must say what the rules ought to be. Hence my suggestion of an Advisory Council.

Nevertheless, the principles of structural fire protection are now fairly well established and form a subject which can and should be taught to students of architecture. I myself have been doing this in the Architectural Association School of Architecture during the last five years. I do not suggest that architects need to know all the complexities of fire protection any more than they need to be expert in the other specialist techniques which are embodied in present day buildings. But they should be conversant with principles. If they were there would be at least fewer cases of plans having to be altered after submission to local authorities for approval. Structural fire protection begins on the architect's drawing board.

In the days of the Briitish Fire Prevention Committee, architects took the lead in an effort to obtain fire safety in the changed urban conditions brought about by the industrial revolution. They have spearheaded many similar causes on behalf of the community, but in this one they seem now content to fulfil the requirements of byelaws - and to grumble at them. They are justified in grumbling because the byelaws are imperfect and the administration of them sometimes unsound. But the remedy is in their own hands.

Interplay of Building Economics & Fire.

Today the community is demanding larger and larger buildings. Architects have to design them so that full value is obtained for the capital expended. Structural protection is, after all, an overhead charge on buildings which has to be paid to ensure safety. The present conflict of ideas between architects, firemen and the officers of local authorities responsible for building seems to me a waste of effort. Co-operation would help towards more fruitful expenditure of that overhead charge and the attainment of standards of safety in which the community could have confidence.

National Income
Conditions in Dc.
Fire Losses
Ventilation

The Problem and its scope

When the Minister of Housing and Local Government was re-drafting the model building byelaws in 1952, several new byelaws, based on recommendations made by the Committee responsible for the Report on Fire Grading of Buildings, were introduced.

The Minister at that time expressed the hope that the new byelaws which were aimed to secure a more precise assessment of fire risk and the protection afforded by structures, would add to safety and reduce the heavy annual losses from fire, while at the same time avoid excessive structural safeguards.

These byelaws which are now administered by most provincial local authorities will cease to have effect without the consent of the Minister after 1963.

In the meantime the officers of the Ministry will no doubt take the opportunity to examine the present model, and in the light of the many advances which are being made in the scientific knowledge of structural fire precautions, consider what further action is necessary to provide every building, its contents and its occupants, with an improved standard of fire protection.

Many highly responsible officers in our Fire Services are convinced that unless more effective statutory powers are made available to enforce proper precautions against fire, there is little likelihood of any appreciable reduction in the annual fire losses in buildings.

This could, therefore, be an appropriate time to take stock of the existing legislation, ask ourselves if the 1952 byelaw amendments are achieving the hoped for measure of protection and examine the need to improve or extend the present provisions.

The whole field of safety precautions against fire in buildings is a vast one, and has many aspects involving the protection of the building and its contents, the control of fire spread within the building and to neighbouring buildings, safeguarding the lives of the occupants and measures to prevent fire and extinguish fire.

There is no simple solution to these problems which can be readily translated into a Penal Code of Practice.

Structural fire protection of buildings is not a modern technique - its effective application dates back to the time when Parliament gave the City of London powers under the Building Act of 1667 to require among other things substantial construction of the carcase of buildings including the provision of fire resisting party walls and the covering of roofs with incombustible materials.

At a later date provincial local authorities began to follow the pattern set by London, consequently most local byelaws have for many years contained provisions which materially assist in limiting the spread of fire between buildings, and have as a consequence reduced the risk of major conflagrations which were such a familiar feature before the introduction of the 17th century Act.

In our anxiety to widen the scope of existing fire protection laws we should occasionally remind ourselves that a very large proportion of our older buildings, erected in compliance with these earlier byelaws have, over the years, provided useful accommodation for their owners, managed to avoid the ravages of fire, and are still structurally sound.

Many of them do not measure up to our present day standards of structural safety and may in some instances be considered high fire risks, but are not these risks due to hazards of occupancy rather than the combustible nature of the building structure?

It is an unenviable task to try and persuade an owner of such a building who has enjoyed long occupancy free from loss by fire that his premises are below some hypothetical standard of fire safety.

We must not, however, assume that because a large percentage of buildings have been immune from fire for long periods our search for effective fire precautions is unnecessary.

The Fire Protection Association inform us that material fire losses in buildings amount to some £26 millions annually and that these disturbingly high costs have far reaching consequences. They say that "the ravages of fire are not the concern of the victim or the insurance company alone - the true loss cannot be measured in terms of money. The loss to the country in production and in exports is incalculable,"

When we recall some of the heavy fire losses which have occurred in buildings during recent years we realise how true these statement can be.

But in our moments of sober reflection we might care to remember the victim who loses an outmoded building, and by reason of wise insurance investment, secures the benefits of a re-erected modern structure, or indeed, the advantage
improved development.

Let us not ove look the fact that in some major fire losses there may be long term advantages to the victim, his employees and to the community.

This is not to imply that we should encourage destruction of buildings by fire.

If we cannot expect any appreciable reduction in fire losses because existing powers are ineffective and the national economy cannot continue to sustain these losses, what positive action should be taken to secure an improvement and what form should it take?

Before any Government can be persuaded to extend the present legislation the case for improvement must be placed beyond all reasonable doubt.

What reliable evidence is there to support the view that there is a need for further legislation to assist in reducing fire losses.

Fire Statistics.

Prior to 1946 no factual data covering fires in all classes of buildings appears to have been available.

During the past ten years, however, the Department of Scientific and Industrial Research and Fire Offices Committee has prepared a statistical analysis of reports of fires attended annually by Fire Brigades in the United Kingdom.

From this analysis it is now possible to obtain a slightly clearer picture of our problem. In England and Wales approximately 45,000 fires occur in buildings annually of which approximately 25,000 are fires in dwelling-houses and flats, leaving a balance of approximately 20,000 in all other types of buildings.

It is also important to note that "the greater part of fire losses can be attributed to a comparatively small number of fires."

Of the £26 million fire losses in 1957 - 4 fires cost a total of £5 million, 20 cost £4 million, and a further 200 fires cost £7 millions, while the remaining £10 millions were spread over 119,000 small fires.

The latest published statistics contain much information with respect to the probable causes of fire in buildings, the number and type of buildings in which fires occur, but they contain no information as to the extent of damage in different types of buildings or possible reasons for fire growth.

A mass of useful data is gradually being collected. This will, in time, enable a more accurate estimate to be made of the causes which influence the development and spread of fires. There is, however, an urgent need at the present time to extend our researches into the reasons why very small fires can so readily develop and become uncontrollable conflagrations. If every small fire could be brought under control before it had a chance to develop, there might be no need to impose more stringent structural fire precautions.

For a number of years there has been a vast amount of scientific research into the cause and effect of fire in a wide range of buildings, all of which is now available to assist those whose responsibility it will be to prepare future fire protection laws. One factor has become clearly obvious from these studies, that most fires in buildings are due to carelessness. It is a familiar truth that in matters of fire, man is by nature a thoughtless and irresponsible creature. Arising from his carelessness springs the need to protect both the building and its occupants from the consequences of his actions.

Existing Structural Protection Laws.

We should, therefore, begin our review of structural fire precautions on the assumption that whatever protective measures are adopted, fire losses in buildings will continue to occur for many reasons, few of which can be controlled by statute.

In general throughout England and Wales, with the exception of London and a few city authorities who have promoted Local Acts, the provisions which control structural fire precautions in buildings are contained within byelaws based on the Minister's Model Building Byelaws.

In addition to these statutory provisions the Fire Grading of Buildings Report provides a most comprehensive review of the whole field of fire precautions in buildings, and has come to be regarded, even though it is now in need of revision, as a most advanced and enlightened advisory Code of Safety Precautions, available for the guidance of all who wish to take advantage of its recommendations. When to these we also add the provisions contained in the Fire Service Act, 1947, which confer powers on all Fire Brigades to give advice on fire protection without cost to the applicants, one wonders why devastating fires resulting in the complete destruction of buildings are still possible.

The reasons may not be far to seek. The limited fire protection provisions contained in building byelaws do not apply to buildings erected before 1953, and there is no statutory obligation on the part of building owners to seek or accept the advice of their local Fire Service, or adopt the recommendations contained in the Fire Grading Report. The byelaws provisions can become effective only when a new building is to be erected or alterations or additions are made to existing buildings.

Fire Resistance of Elements of Structure

The present byelaws contain provisions designed to minimise the spread of fire between buildings by requiring various parts of the building to resist fire for specified periods. These requirements follow closely the recommendations of the Fire Grading Committee which show how the fire resistance of certain elements of structure can be equated to what has now become known as "Fire Load". This has enabled a classification of buildings to be made according to the degree of fire risk represented by low, moderate or high fire loads.

For the various classifications, which are more commonly described as occupancy gradings, the byelaws prescribe notional periods of fire resistance for certain elements of structure ranging from ½ hour to 4 hours according to use category - that is, whether the building is a domestic building, a public building or a building of the warehouse class.

These structural safeguards are based on the assumption that for byelaw purposes all fire loads are constant within the same occupancy grading.

For example: If a warehouse class building used wholly or predominently for storage exceeds 250,000 cubic feet or exceeds 75 feet in height, the external walls, load bearing walls, floors, columns and beams are required to have a fire resistance of 4 hours.

These requirements do not, however, take into account the fire load represented by the nature of the materials stored which could have a very low or an abnormally high fire load potential, moreover, whatever the degree of fire resistance required for any separating walls, they need not be imperforate to resist the spread of fire, but may contain openings with doors or shutters having a fire resistance of half the period required for that of the wall. Unless these provisions are extended to require the doors or shutters to be self-closing, separating walls will have little value as fire and smoke barriers.

No relaxation in structural fire resistance standards is permitted whatever the fire load represented by the occupancy hazard. Nor is any relaxation permissible if the building is fitted with a sprinkler system or an effective fire alarm system.

This omission to acknowledge differences in fire hazards by reason of usage is a major factor for consideration during the forthcoming review of model byelaws. It is indeed a factor which has come under review recently by the Advisory Committee on the Control of Construction of Buildings in London. Dealing with the question of emphasis in byelaws on protection from fire the Committee reports - "there should be a more detailed sub-division of buildings from the fire risk point of view based on the categories of use and the degree of fire hazard associated with that use."

Some criticism of the present byelaw standards to safeguard the building structure from damage by fire has been made by the Committee appointed to examine the law regulating buildings in Scotland. "There is scope for argument" says the Committee, "as to how far building control should go towards ensuring that every building should have a good chance of resisting complete burn-out should there be a fire.

So long as the structure is such that there is no risk to other buildings and the occupants of the building itself can readily escape before it goes up in flames, it may be asked whether it is justifiable for building requirements to force an owner to erect a building which would have a greater resistance to fire than he would otherwise be prepared to accept".

Now that we are approaching the date for the revision of provincial building byelaws these views are of special interest. They are a clear indication that our first serious experiment in the field of structural fire precautions is in need of careful overhaul.

We are being constantly reminded that it is not in the interests of the national economy to allow buildings to be erected with readily combustible structural elements.

But it is permissible under the present byelaws to erect a storage building of unlimited cubic capacity or a single storey public building of 100,000 cubic feet with combustible external walls if the building complies with certain specified distances of isolation.

Buildings of this nature may not, by reason of their isolation, involve their neighbours if fire occurs, but the whole structure and its contents may rapidly become a total loss.

It is also difficult to understand why the present byelaws impose siting restrictions on buildings of light frames construction even when clad externally and internally with materials possessing a reasonably high degree of fire resistance, but at the same time places no restriction on the use, in buildings of high fire load classification, of large areas of external glazing which may not afford any resistance to fire.

During the drafting of the 1952 model building byelaws a new provision was introduced to require openings in external walls which were vertically above one another, to be suitably protected so as to prevent the spread of fire from lower to upper floors.

This requirement can be met by the provision of solid walls of a specified depth between the head of one window and the cill of the window immediately above, or by providing balconies with solid floors constructed between the lower and upper windows, projecting two feet from the wall and extending laterally beyond each limit of the overlap.

Architects have complained that this byelaw was not only hastily conceived and introduced before conclusive evidence was available to justify its inclusion, but has a most restrictive effect on the design treatment of elevations.

An investigation is, however, being carried out at the Fire Research Station in order to establish the part played by the external walls of multi-storey buildings in restricting the spread of fire vertically on the face of a building.

If the present exacting standards of fire resistance for walls, floors and structural supports are essential, should not similar standards apply to roofs ?

The roof of every building is an important element in preventing fire spread.

Roofing byelaws are designed to afford protection against spread of fire into the building or to adjacent buildings. To this end the byelaws contain a list of roofing materials which are deemed to satisfy the fire resistance requirements. One of these permitted materials - metal sheeting covered on both inner and outer surfaces with bituminous material was the material used on a large factory which became involved in fire and proved to be the major factor which contributed to the heavy fire loss sustained.

A roof which has an external veneer of fire resisting material affords little protection against spread of fire from within the building if the covering material is simply supported on a combustible frame which is itself exposed to attack by fire. The byelaws contain no provisions which require a roof to be adequately fire resistant to internal fire.

Cubic Extent of Buildings

During recent years a number of devastating fires have occurred in premises where large undivided floor areas appear to have aided the growth of the fires. These occurences give weight to the argument that large scale fire losses could be reduced if every local authority had the power to enforce cubical limits on the size of compartments.

The case for sub-dividing buildings into small fire resisting cells or providing automatic sprinklers where an optimum size is exceeded, is gradually gaining support.

A few authorities have statutory powers to impose limits of 250,000 cubic feet in certain classes of buildings unless special precautions are taken, but the imposition of such an arbitrary cubical restriction will find little support until there is more reliable data to establish the optimum size of compartments, beyond which special precautions are required. This must obviously vary with different types of occupancies. It is essential in my opinion to take the use of the building into consideration.

Safe Escape From Buildings.

Measures to reduce fire hazards in buildings are gradually emerging from the trial and error stage to one where applied science is providing reliable technical data on which safety requirements can be based.

No such information was available during the drafting of legislation to provide safe escape for the occupants of buildings.

The principal legislation for the safeguarding of human life from fire in buildings which is contained in the Public Health Act, 1936 and the Factories Act, 1937, provides that the means of escape shall be "such as may reasonably be required in the circumstances of each case or as the authority may deem necessary".

Neither Act gives any guidance as to how these essential safety precautions can be achieved.

Mandatory provisions of this nature give rise to difficulties in administration, provide a variety of interpretations and tend to bring the law into disrepute.

Modern research has shown that safe escape from buildings depends largely upon the accurate assessment of the life risk, the measures adopted to prevent escape routes being attacked by fire and rendered unuseable by smoke and hot gases and the provision of properly enclosed staircases.

The ever changing concept of structural fire precautions has from time to time caused much confusion of thought and produced a number of conflicting recommendations.

There is always the danger that we may, while searching for perfection, overreach ourselves by imposing exacting requirements which are unrelated to potential fire hazards.

There is, moreover, a growing body of opinion that some of our present standards of structural fire resistance are exceesively stringent.

Our failure to effect any appreciable reduction in fire wastage during recent years underlines the essential need to examine carefully every aspect of the causes which assist the development and growth of fires in buildings.

There can be no better summary of our present needs than that contained in the Fire Research Board Report for 1956, which says "with the increasing use of new materials, new forms of construction, new designs of buildings and new demands from industry, a more fundamental approach to the whole problem of fire protection has become necessary."

How is the approach to be made?

Our first experiment in the field of structural fire precautions has provided a higher standard of fire resistance for certain elements of structure than was previously required.

These standards must inevitably tend to reduce the risk of total collapse when buildings become involved in fire of high intensity.

They will not, in every case, provide improved protection against spread of fire within the building or to neighbouring buildings, nor will they assist in reducing fire losses in buildings built before the operation of the 1952 building byelaws.

Future Fire Protection

If, in the future, we are to make a serious contribution to the reduction of fire wastage there must be a more radical approach to the unresolved problems of fire protection.

The solution to some of these problems may be within our reach, now that the fundamental principles of fire protection are more clearly established.

If fire protection laws are to be effective in reducing fire losses they must be made to apply to all buildings whether new or existing. It would, however, be unreasonable to expect the present byelaws standards of structural fire resistance to apply to existing buildings in consequence of the heavy costs involved. We must seek other means of minimising the risks of structural fire damage.

It is becoming increasingly obvious to many fire Officers that unless the hazards of use and occupancy of buildings can be brought under more effective control, the present byelaw standards of structural safety will not in themselves provide an assurance against a complete burnout.

The answers to many of our fire protection problems are to be found in the recommendations of the Fire Grading Committee. Where experience has shown that these recommendations, when adopted, have been a contributory factor in the reduction of fire growth, is not this a sufficiently good reason to suggest that they should be given power of enforcement?

The Ministry of Labour and National Service has been looking into the need to extend precautions in factories.

As a result Parliament is now being asked to extend the Minister's powers to enable him to make special regulations as to measures that must be taken to reduce the risk of fire breaking out and fire and smoke spreading in any factory. Requirements may be prescribed with respect to the internal construction of factories and the materials which may be used in that construction.

These extended powers are being hailed by fire protectionists as a most progressive and enlightened piece of legislation.

We should not, however, overlook the fact that power was given to the Secretary of State under the Factories Act, 1937, to make regulations as to means of escape in case of fire, but no such regulations have been made.

But why should the standard of safety in factories be higher than those which are enforceable in other types of buildings?

Is it more important to save a factory building and its occupants than other types of buildings and their occupants?

The life risk in many hotels, boarding houses and hostels can be much more serious than the life risks in some factories.

Fire precautions which are related to the fire hazards should be made to apply to all buildings whatever the fire load classification or occupancy grading.

If we cannot place too much store on the present statutory requirements to reduce fire losses, and a Code of Practice that would provide a high standard of safety against all foreseeable fire hazards in buildings of every classification cannot be prescribed, we might at least begin our second experiment in structural fire protection by considering the adoption of measures similar to those which are now proposed in the Factories Act 1937 to 1958,

The future course and scale of research and investigation into safety from fire in buildings will be influences to some degree by the interest displayed by the Architectural profession.

This vast subject will not, however, be solved by hastily conceived legislation. There must be a process of gradual adoption based upon an intensive study of every factor which influenced the safety of the building, its contents and its occupants.

Above all our better judgement must not be clouded by a burning enthusiasm for wider and more exacting powers.

Whenever progress appears to be slow let us recall the words of the Finnish poet Leino -

"He who is fire, let him serve the fire,
Thy destiny will be to dust returning,
But until then there will be time for burning.".

(1) Both authors rightly stressed the necessity of fire resisting walls being impervious [illegible] to fire, ~~[illegible]~~ use of self closing doors. — Services.

(2) Bird. Studd. ~~international~~ ~~cooperation~~. — need for fundamental approach
Statistics,
Fire interchange, — models, — what is a model,
difficult — solution takes time, — some results already,
what is coming out of all — structural precautions
planning buildings against development of fire. C.I.B. W.P.F.R. — Swedish High Flats Basements

(3) Bird. International Cooperation
(1) Collection of statistics.
(2) Fire Test.
(3) models.

~~(3) Old Buildings — Large fire losses.~~

(4) Studd
Factories — Space large. — compartmenting must be set against exigencies of production. Must find how to prevent fires spreading rapidly some other way. — Sprinklers Factories Ins. Act will do something. emphasised fires will spread over stored materials. — Fire Alarms.
Roof vents
— Striding again using models.
fire burn more rapidly when vented, but Brigade have a better chance of putting fire out.

(5) Roofs — Studd says should be fire resistant at internal finish